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Overpowering. (How the powers ontology has over-reached itself)

Abstract

Many authors have argued in favour of an ontology of properties as *powers* and it has been widely argued that this ontology allows us to address certain philosophical problems in novel and illuminating ways, for example causation, representation, intentionality, free will, and liberty. I argue that the ontology of powers, even if successful as an account of fundamental natural properties, does not provide the insight claimed as regards the aforementioned non-fundamental phenomena. I focus on and criticise the powers theory of causation presented by Mumford and Anjum (2011), and argue that related criticisms can be directed at other abuses of (the ontology of) powers.

1 Introduction—the powers ontology

An ontology that holds that properties are *powers* has found considerable popularity in recent years. What are powers? I shall address this question in more detail below. But for now it suffices to say that powers are properties that are dispositional in nature. It might be thought easier to say simply that powers *are* (the same as) dispositions. But this is a mistake, as I shall argue. We can see immediately that it would be at least very misleading to say that powers are dispositions. For everyone thinks that things have dispositions. But it is highly contentious whether anything has a power. One reason why the powers ontology is interesting is that it is held to be a contrast to the ontology associated with ‘Humean’ metaphysics. I shall explain

how shortly. Some add that it is a return in important ways to an ontology of an Aristotelian variety (Marmodoro 2010a; Groff 2013).

What are the reasons for believing in powers? Amongst such discussions of and arguments for powers, I distinguish two types or levels. A(bstract)-type discussions operate at a fairly abstract and general level of metaphysics. The focus on the benefits of powers in connection with an account of laws or the cross-world identity of properties. S(pecific)-type arguments propose that powers can provide superior accounts of certain specific phenomena of philosophical interest, such as causation, intentionality, free-will, and even morality. So, for example, the directedness of powers allows them to play a role in explaining intentionality.

How do A-type and S-type arguments relate? That question is the focus of this paper. I argue that the relationship is rather less close than is generally thought. Discussions typically proceed as if A-type arguments provide the basic reasons for thinking that there are powers at all, while S-type arguments show what work this ontology can do in specific instances.¹ For this strategy to work, it needs to be the case that A-type arguments establish the existence of entities that are of a kind suited to do the work required by S-type applications. I argue that even if sound, A-type arguments do not do this. My principal reason, to be articulated in detail below, is that A-type arguments support only the following thesis:

The Fundamental Powers Thesis (FPT) Many or all fundamental natural properties are powers.

However, S-type arguments argue that *macro* phenomena should be explained in terms of *macro* powers. So they need the following:

The Macro Powers Thesis (MPT) Many or all macro properties are powers or clusters of powers and that such properties play a role in explain-

¹For example, Mumford (2004) gives A-type arguments for powers while Mumford and Anjum (2011) take that earlier work as given in formulating a powers theory of causation. Molnar (2003) concentrates mostly on A-type arguments before concluding with a chapter 'Powers at work' pointing towards S-type applications of the ontology. Similarly Ellis (2002) promotes an A-type theory of powers before suggesting that it solves other philosophical problems, such as in the philosophy of mind.

ing important phenomena involving macro entities, such as causation, intentionality, and free-will.

(I shall use ‘macro’ to be a shorthand for ‘non-fundamental’—while recognizing that properties that appear at the fundamental level can also be properties of macro entities.)

So, I argue, those who accept the powers ontology on the basis of the A-type arguments are not thereby committed to believing in macro powers. Or put another way, those who do move from A-type arguments for powers to S-type applications are guilty of overextending the powers ontology. In particular there are those who use A-type arguments (which at most entail a version of FPT) in order to maintain *pandispositionalism*, the view that all properties (fundamental and non-fundamental) are powers. I shall also consider whether there are any S-type arguments for powers independently of A-type arguments.

1.1 The argument in summary

In section 2 I articulate what it is to be a power, which involves a central commitment to the modal fixity of powers—the fact that a power retains the same causal/dispositional role across possible worlds. This contrasts with central commitments of a Humean metaphysics (properties are quiddities, no necessary connection between distinct existences). I look at the A-type arguments for the existence of powers—these focus on features related to their modal fixity, such as the ability of powers to provide an account of laws of nature and an account of property identity. I note that these concern fundamental not macro properties, so these are arguments for FPT and do not support MPT. I consider the possibility that *irreducibility* is at the heart of the powers concept, but do not find that the resulting ontology is especially significant. I then lay out the competing views about whether any fundamental properties are powers and expand that to cover macro properties. Of particular note is *pandispositionalism* (PD): *all* properties (fundamental and macro) are dispositions.

In section 3 I mount a strong *prima facie* case against PD, viz. that many properties just do not seem to be powers at all, because they have no dispositional character.

In section 4 I consider an argument in favour of MPT that starts from the assumption that there are fundamental powers. The argument then maintains that because (ontic) macro properties supervene on or are constructed out of fundamental powers, they too must be powers. I show that this reasoning fails.

In section 5, I describe an implicit argument for MPT based on the thought that dispositions are ubiquitous. Supporters of the powers ontology often use ‘disposition’ and ‘power’ as synonymous, which implies that powers are ubiquitous also. But the equation of disposition and power is highly contentious. Disposition talk is available to opponents of powers (such as Humeans) as well as to their supporters. We must be careful to distinguish between talk of powers (which is metaphysically loaded) from ‘mere’ disposition talk (which is not).

In section 6, I tackle the argument for MPT that it provides a satisfactory and distinctive account of causation. Mumford and Anjum argue that causation is vector-like and that MPT accounts for this fact. I reply that (i) insofar as causation is vector-like, then the competing ontologies, including MH, can account for this equally well; and (ii) neither powers nor causation are vector-like in any case.

In section 7, I argue that the problems besetting the attempt to give a powers account of causation (and thereby support MPT) are not limited to their theory but can be found elsewhere. For parallel attempts to apply PD in other areas of philosophy suffer from analogous problems. For example, several provide *dispositional* accounts of some phenomenon from which it is fallaciously inferred that they have thereby shown the value of the powers ontology.

2 The powers ontology

2.1 Properties, ontic and otherwise

First, an important clarification: we need to be clear what we are talking about when we use the term ‘property’. We are liable, especially in philosophy, to use the term

liberally, so that (almost) any predicate defines a property: ‘the property of being such that ϕ ’ is a property for any predicate ϕ . Yet we do not think that that every property in this sense is an entity, a component of our ontology of properties. So our discussion should be limited to properties in a more heavyweight sense of ‘property’ that does have ontological implications. Some use the terminology of ‘sparse’ properties to indicate this, but those who do so typically think of the sparse properties as the natural properties, those that would be mentioned in a correct complete science. But some might want to argue that some non-natural properties are genuine entities.² And so to avoid confusion, I will use the terminology of ‘ontic’ properties for properties considered as entities and I will use ‘predicatory’ to indicate the looser, ontologically uncommitted use of ‘property’.

Powers theorists take themselves to be advocating a novel ontology of properties. If a theorist were to tell us that there are powers but that they are predicatory properties, then the theory would lose much of its interest. In particular it would not be a theory that make a striking contrast to, for example, Humean ontologies. Predicatory properties come cheap and a Humean can happily accept them without inconsistency. Consequently ‘property’ as used below will mean ‘ontic’ unless otherwise specified.

2.2 What are powers?

There isn’t unequivocal agreement on what exactly a power is. Above I said that a power is a property that is dispositional in nature (see also Jacobs 2007). What does that amount to? Most advocates of the powers ontology agree with one or both of the following:

²We should note that Mumford and Anjum (2011: 17) do not limit their conception of powers to the natural properties (let alone the fundamental ones): ‘We also wish to avoid rushing into a sparse theory of properties as advocated, for instance, by Armstrong (1978). We do not say, as in Bird (2007a), that the only real powers are fundamental. Higher-level properties, such as being fragile, may be messier in a scientific sense, but we need a better reason than that to ignore them.’

- a.* A power is an ontic property that has a dispositional essence (Swoyer 1982; Ellis and Lierse 1994; Shoemaker 1998; Bird 2007a; Ellis 2001; Bauer 2013; Yates 2013).³
- b.* A power is an ontic property whose identity is given by its causal/dispositional/nomic role (Shoemaker 1980; Molnar 2003; Mumford 2004; Bird 2007a; Engelhard 2010).

(Explanatory note: in *b* the causal/dispositional/nomic role of the property concerns its causal/dispositional/nomic relations to other properties. However, this should not be taken to imply that causation or nomicity is metaphysically prior to the operation of powers. I shall use the expression ‘dispositional character’ to capture this role, without any implication that this feature is necessary or essential. So *a* asserts that the essence of a power is its dispositional character, *b* asserts that dispositional character fixes a power’s identity.)

Characterizations *a* and *b* are clearly related. While those cited under *a* use the language of dispositional essence, Mumford (2004: 166–71) eschews essence talk, but agrees that the causal role of powers fixes their identity and that a power has its causal role necessarily.⁴ What all are agreed on is that the very same power could not have a different dispositional character or causal role: that character/role is fixed across possible worlds. This feature I capture by saying that:

(Modal Fixity) Powers are modally fixed properties.

Powers, being modally fixed properties, contrast with properties that are *quiddities*. The latter are properties with primitive identity; they do not retain dispositional character across worlds; they are modally variable properties. The literature on dispositions and powers often talks of ‘categorical’ properties, the latter being properties that do not have a dispositional character even contingently. If a categorical property does not have dispositional character, it won’t have a dispositional

³According to Handfield (2001) and Jacobs (2011), Heil (2003) and Martin (2008) can be added to the list of those who hold an essentialist view of powers, though their two-sided view complicates matters.

⁴Because of *b*, powers theorists hold that to think that properties are powers is to commit to a view about property identity. Mumford (2004: 171) says ‘Swoyer’s is an essentialism about the causal roles of properties. I say more or less the same but I would again downplay the essentialism. We can say merely than a property’s identity is fixed by the causal role it plays in relation to other properties.’

nature or essence. And so categorial properties and quidditistic properties are usually thought to be the same.

2.3 Arguments for powers

I shall briefly mention the principal arguments for the powers ontology in order that we can understand the nature of A-type arguments. These focus on two areas: laws of nature and property identity. As we shall see, such arguments support FPT but not MPT.

The Humean view of laws holds that the laws are regularities within the pattern of property instantiations at the fundamental level (or supervene on these) (Lewis 1973: 73). Nothing explains that fundamental pattern of instantiations. Because (according to the Humean) properties are quiddities and so are modally variable, in a different possible world the same set of properties and objects could be related by a different set of instantiations with, therefore, a different set of laws. Properties may be related to one another by causation or by a dispositional connection. In the Humean picture these supervene on the laws, and so are entirely contingent. Other views of laws share some of this Humean picture. The 'DTA' nomic necessitation view of laws of Dretske (1977), Tooley (1977), and Armstrong (1983) holds that laws are relations of nomic necessitation between properties and these explain the regularities. The modal variability of properties means that different relations of nomic necessitation hold in different worlds. The commitment to properties as quiddities and so as modally variable is a manifestation of the Humean dictum that there are no necessary connections between distinct existences. In both pictures the laws are imposed upon properties, in the one case by the contingent pattern of property instantiation, in the other case by the contingent relation of nomic necessitation. The powers theorist, by contrast, thinks that powers are modally fixed properties, and so in a world of powers the very existence of those powers relates those properties to other properties. So such relations (causal, dispositional, nomic) are explained by the very nature of the properties rather than being imposed upon them. Consequently, the thesis that there are powers provides an explanation of why there are laws while avoiding problems that beset the regularity and nomic necessitation

views (Swoyer 1982; Bird 2007a). Alternatively we can say that this ontology shows how we can dispense with the hypothesis that there are laws at all (Mumford 2004).

The powers theory also provides an account of property identity, of what it is to be a particular property. A property could not have a different set of dispositional relations with other properties. P and Q are the same property iff they have the same dispositional character. This holds both within and between possible worlds. This contrasts with the Humean view which must posit primitive identity and difference between properties. The latter means that one could swap the dispositional (and causal and nomic) roles of two properties and thereby generate a genuinely distinct possible world. The powers theorist thinks this is absurd: to swap dispositional roles is to swap properties too and there is no genuine change. The Humean view also allows for multiple properties to fulfil the same role in the same world. This, the powers theorist may argue, leads to scepticism about our best scientific theories that assume one property per role.

The principal arguments against powers also focus on these areas. The powers view makes laws metaphysically necessary. But we have reason (such as intuition, role in counterfactuals etc.) to think that they are contingent (Sidelle 2002). If properties have their identity given by their dispositional role, and that role concerns how they relate to other properties (because it is the instantiation of some second property that constitutes the manifestation of the first), then it looks as if there is a regress: the identity of the first property depends on the identity of the second, which depends on the identity of a third ... etc. (See especially Robinson 1982; Lowe 2006, and also Swinburne 1980; Blackburn 1990. See Holton 1999; Bird 2007b for responses.) An important recent criticism of the powers ontology by Barker (2013) focusses on the ability (or inability) of the powers theory to respond to this with a broadly 'structuralist' answer. He also questions the powers theorists' account of the necessity or modal force that attaches to laws.

I have sketched these arguments in order to show that the properties that they are concerned with are *fundamental* properties. The powers account of laws is *indirect* in that it does not attempt to provide an account that will allow us to analyse any given law of nature. It does not provide an account of Gresham's law in economics

or Snell's law of diffraction in terms of powers. Rather it tells us what in the world explains why there are laws at all. For that purpose an account of the nature and relations between fundamental properties, explaining how fundamental laws arise from them, suffices.

The same point holds for Mumford's eliminativism about laws, according to which the work supposed to be done by laws is in fact done by powers. In order for this task to be achieved, a powers theory of 'lawlessness' does not need to argue that every property is a power; it need only argue that the work of fundamental laws is done by fundamental powers. For once we have eliminated the fundamental laws, a fortiori the non-fundamental laws are eliminated also: to show that there really isn't any metaphysical entity or fact that is Faraday's law of electromagnetic induction, it suffices to show that the hypothesis that the fundamental properties (whatever they may be, e.g. charge, mass, spin etc.) are powers allows us to eliminate the fundamental laws. If we do that, Faraday's law falls in any case—we don't have to show that the properties it mentions (electromotive force, magnetic flux) are powers too.

The dispute over whether properties have their identity primitively or given by what they do only makes sense for fundamental properties. For that dichotomy (power or quiddity) does not hold for non-fundamental properties since it is clear that they might have their identity in yet other ways, e.g. in terms of how they are constituted out of more fundamental properties (a view of non-fundamental property identity open to both those who think that fundamental properties are powers and those who think they are quiddities).

So if even if we accept the laws and identity arguments for powers and reject the corresponding criticisms, including those mentioned above (e.g. Barker 2013, also Vetter 2009 and others), we are not thereby committed to (nor are we thereby entitled to) belief in non-fundamental powers. The standard A-type arguments for powers establish only FPT and do not support MPT.

2.4 Irreducible dispositions

Often authors talk of 'irreducible dispositions' and 'ungrounded dispositions' (I'll take these to be equivalent). For some it might be that irreducibil-

ity/ungroundedness is at the heart of the power concept, and I therefore now address whether this might supply a concept of power both distinct from the concept just articulated above and also important as providing a new ontology.⁵ I consider three interpretations of ‘irreducible disposition’.

First, talk of irreducible dispositionality can be just another way of referring to the fact that the dispositional character of powers is essential to it, rather than imposed upon it by the laws of nature. The quidditist holds that a fundamental property’s dispositional character results from the independent and contingent laws of nature—on this view, that is to reduce the property’s dispositionality (Kistler and Gnassounou 2007: 39, Crane 1996). So if we assume (as the literature does) that the two options regarding a fundamental property are that it is either a power or is a quiddity, then a commitment to irreducible dispositions is a commitment to powers as discussed immediately above. Hence this notion of ‘irreducible disposition’ does not generate a distinct ontology of powers.⁶

Secondly, ‘irreducible disposition’ might refer to a disposition *D*, such that the statement ‘*x* has *D*’ cannot be analysed in non-dispositional terms. I strongly suspect that the resistance of dispositional locutions to analysis provides a fair proportion of the motivation to think of dispositions as genuine entities.⁷ But this is a confused way of thinking. It assumes that the point of such analysis would be to eliminate dispositions, and so the failure of analysis is a reason to believe in ‘real dispositions’ (in Mumford’s phrase). The history of the analysis of dispositions is however not concerned with ontological elimination. Rather, the initial impetus came from verificationism. For *prima facie* a non-manifesting disposition is empirically indistinguishable from an absent disposition. So a natural answer is to analyse dis-

⁵Molnar (2003) *may* be an example of someone for who irreducibility is a key element of the concept of power, though even he seems to endorse *b* above.

⁶Tugby (2013: 452) is explicit that this is his understanding of irreducible dispositionality. Although Tugby does not comment on fundamental properties, this notion of irreducible disposition makes sense only for them. For it doesn’t make sense to ask whether a non-fundamental property has its dispositionality imposed by the laws of nature.

⁷For example, I think that this is present in Martin (2008), whose dispositional account of mind is preceded by an argument for the ‘reality’ of dispositions built around a discussion of the failures of analyses of dispositions.

positions in terms of the conditions that would lead to their manifestation. That (if successful) would have satisfied verificationism, but it has no implications for ontology, for to analyse is not to eliminate. Later Mellor (1974: 157) would articulate an attitude (not his) to dispositions thus ‘Dispositions are as shameful in many eyes as pregnant spinsters used to be—ideally to be explained away, or entitled by a shotgun wedding to take the name of some decently real categorical property.’ That might sound slightly ontological, but just as spinsterdom or marriage makes no difference to the existence of the pregnant woman, analysis makes no difference to the existence of things. As Mellor himself notes, although he talks of ‘real’ dispositions, he is not begging the question against the nominalist (i.e. someone who says that there are no ontic properties here), since his argument can be understood as saying that dispositional predicates are not always coextensive with non-dispositional predicates. It should be clear that the availability or otherwise of an analysis of disposition statements has no direct implication *per se* for ontology. For example, the simple conditional analysis of dispositions:

(SCA) x has the disposition to manifest m in response to s iff were x to receive s then it would manifest m .

is consistent with the existence of ontic dispositions (and with the denial of their existence). One might hold that SCA is true and that’s because the existence of a property with the dispositional character on the left hand side of SCA is the truth-maker for the conditional claim on the right hand side. Nor does the lack of any satisfactory analysis of dispositions imply the existence of ontic dispositional properties. What debates about the analysis of dispositions focus on is typically predicates such as ‘...is fragile’ or ‘is disposed to m when s ’. The lack of an analysis of such *predicates* tells us nothing about which *entities* there are in our ontology, i.e. which ontic properties there are. That remains true even if the analysanda are the nominal expressions ‘fragility’ and ‘the disposition to m when s ’. For what we need is an argument that these expressions refer to ontic properties, not to predicatory ones, and the lack of analysis does not indicate the former rather than the latter. So the absence of a satisfactory analysis of dispositional expressions is no evidence that we need an ontology of powers.

Thirdly, ‘irreducible disposition’ might mean ‘disposition that is not identical to its causal basis’. Note that this interpretation is not equivalent to the second. D might be identical to causal basis B without its being the case that ‘ x has D ’ can be analysed as ‘ x has B ’—this will be another case of non-analytic identity (Mark Twain is Samuel Clemens, the morning star is the evening star, etc.). The SCA has no implications for the identity of dispositions. So we need to consider this proposal on its own merits. Let us say that ‘ x has disposition D ’ is true and it is false that $D = B$, x ’s causal base for D . That might be because D is multiply realisable: y has D also but does not have B . Is that a reason to add D to our ontology? Not as it stands. For we can construct clearly predicatory dispositions that are multiply realisable. Consider a disposition D with stimulus s and disjunctive manifestation $m_1 \vee m_2$. One object, x , may have D because it will respond to s with m_1 in virtue of causal basis B_1 . While y has D because it responds to s with m_2 , in virtue of causal basis B_2 . If we select m_1 and m_2 to be sufficiently different, then B_1 and B_2 will have to be different (e.g. make D the disposition to respond to being placed in water either by dissolving or by exploding). So some irreducible dispositions are not ontic, and we thus need a supplementary argument to show that in some cases the disposition in question *is* an ontic property. The right place to look would be at the ability of the disposition to provide coherent explanations of phenomena, e.g. by playing a role in a true scientific theory. The gerrymandered disjunctive disposition would be excluded, but many dispositions found in science will be admitted, for example: water solubility, being Gram-positive, being magnetic, having high inductance, etc. Cartwright’s (1989) work on the significance of capacities in science may be seen as making the case for the ontic status of such properties.

If there are, for this reason, ontic properties that are dispositional in character, does this make them an interesting addition to ontology that might be an alternative to the conception of powers articulated above? The answer is not immediately obvious. While the irreducibility of dispositions is discussed in the literature, the significance thereof for ontology is not. The onus is on those who take this to be the real basis for an ontology of powers to make that case. One reason for suspecting that these dispositional ontic properties do not mark an important ontological

departure is that they are consistent with a basic Humean ontology. Let us assume the Humean mosaic of the instantiation of quiddities by basic entities (e.g. space-time points). (If you are a DTA fan, then add also the instantiation of second and higher order relational quiddities. While not a vanilla Humeanism, this still retains a Humean ontology of properties as quiddities.) Have we thereby committed ourselves to the identity of dispositions and their causal bases, or denied dispositions a role in science? Clearly not, the Humean picture concerns the way reality is at the most fundamental level. The non-fundamental aspects of reality may supervene on that fundamental level in highly complex ways that defy reduction. If so there may well be irreducible but supervening (emergent) properties, including dispositional ones. I note in this context that Cartwright (1989: 1–3) takes her view of real capacities to be anti-Humean. But this is because she rejects the Humean regularity theories of laws and of causation. And one may reject those while keeping the basic Humean ontology of quiddities (e.g. the DTA nomic necessitation view of laws and the Lewis counterfactual account of causation).

In conclusion, the first interpretation of ‘irreducible disposition’ just denotes powers as discussed above, and so is not a distinct notion. The second interpretation is irrelevant to ontology and so can be ignored. The third interpretation might be the basis for a conception of the ontology of powers distinct from characterizations *a* and *b*. But its significance has yet to be demonstrated—that ontology is consistent with a Humean basic ontology and furthermore cannot be supported by the standard A-type arguments concerning laws and identity. Hence the conception of powers I shall use remains the standard one focussed on *a* and *b*, with modal fixity as a central component.

2.5 The macro powers thesis and its competitors

Characterizations of powers *a* and *b*, largely definitional in function, leave it open which if any properties are powers. So what are the options regarding views of whether properties are powers?

As regards fundamental properties, the three options discussed in the literature are:

Powers monism (PM_F) All fundamental properties are powers (e.g. Mumford 2004; Bird 2007a).

Mixed view (MV_F) Some fundamental properties are powers and others are quiddities (the 'categorical' properties) (e.g. Ellis 2001; Molnar 2003).

Categorical monism (CM_F) All fundamental properties are quiddities (e.g. Lewis 1983; Armstrong 2012).

I have given the views the subscript F to indicate that they are views about the fundamental properties and do not make any direct assertions about macro properties. Some of those who endorse the above views are explicit restricting their views to fundamental properties. For example Bird's version of PM_F, monistic dispositional essentialism is view only about fundamental properties. Lewis's endorses CM_F, and it is clear that his view is one only about fundamental properties (Black 2000). On the other hand, Ellis (2012) does not make such a restriction in his version of the mixed view.

Categorical monism (quidditism) is a feature of Lewis's metaphysics:

Metaphysical Humeanism (MH). There is a Humean mosaic of basic objects and their basic properties. Those basic entities are metaphysically independent of one another. Laws supervene on the mosaic (they are certain kinds of regularity in the mosaic) and are therefore contingent.

In Lewis's MH, the basic properties are quiddities—this allows them to be metaphysically independent of one another, whereas powers are not. Categorical monism also encompasses the DTA nomic necessitation view of laws. Note that while CM_F allows for the contingency of natural laws, PM_F holds that the laws are necessary, since they are consequences of the essential connections between powers—or, alternatively, that laws may be eliminated because their work is done by the powers.

How do we extend the above to *all* properties, fundamental and non-fundamental? We are faced with the problem that not many of those who write on these issues are explicit about this question. The views I shall consider the following.

The strongest version of MPT is:

Pandispositionalism (PD) All properties are powers or clusters of powers.

PD entails PM_F , but it not entailed by it.⁸

Those who hold MV_F must reject PD, but they may still endorse MPT. Ellis (2012) is an example. Call this view:

Unrestricted Mixed View (UMV) There are powers and non-powers at both the fundamental and macro levels. Powers play an important role in explaining phenomena at both levels.

Someone might hold PM_F yet deny that any macro properties are powers and so reject MPT:

Restricted powers monism (RPM) All fundamental properties are powers but no macro powers are.

Discussions of CM_F give little or no attention to how they bear on or extend to non-fundamental properties. But it is clear that no-one who endorses CM_F (i.e. no-one who rejects any power at the fundamental level) sees an important role for powers at the macro level. So adopting MH in particular is one way of rejecting MPT

The central conclusion of this paper is that we have no reason to accept MPT, the macro powers thesis. It will be more straightforward to argue against PD than the weaker UMV, but we shall see that UMV falls as well. One of the strategies will be to show that when MPT seeks to explain certain macro phenomena in terms of powers, alternatives inconsistent with MPT—RPM and MH—can provide equally strong explanations.

3 Counterexamples to pandispositionalism

In this section I tackle MPT and in particular its strongest version, PD, head on. First, I present as counterexamples to PD properties that certainly do not seem dispositional in nature, i.e. they do not seem to be powers. These constitute strong prima

⁸Pandispositionalism is also called 'dispositional monism'. But the latter is sometimes used to denote what I've called 'powers monism'. So I am here avoiding 'dispositional monism' to prevent confusion.

facie evidence against PD. While the rejection of PD is consistent with continuing to affirm MPT, the latter is weakened also.

On the face of it there are plenty of genuine macro properties that are not dispositional in nature or essence. In many sciences the properties concern structure or composition, not disposition—in chemistry: being metallic, being aromatic (the property of being a chemical compound that contains a benzene ring), being heterocyclic (containing a ring made of carbon and other atoms), being covalent (of a bond, in virtue of the electron distribution giving rise to the bond); in crystallography: being homodesmic (a property of crystal structure whereby its bonds are all of one form, either all ionic or all covalent); in biology: the property of being heterozygous at a particular locus (having different alleles at that locus); in medicine: being leukopenic (having a low white blood cell count). Other properties concern the relationship of the entity of other things, e.g. position in a structure—in chemistry: being a transition element (a property had in virtue of the element's position in the periodic table); in evolutionary biology: the property of being a dinosaur (had by all and only descendants of a certain ancestral archosaur population of the middle to late Triassic); in zoology: being a manus (the property an anatomical structure has in virtue of being the distal part of an animal's forelimb, e.g. the hand of a human the flipper of a dolphin or the end of a wing of a bird); in medicine: being pericardial (the property of surrounding the heart). Science is full of references to properties that are not at all dispositional.

In response to the claim that certain alleged categorical properties are not dispositions, e.g. sphericity (the property of being a sphere), Mumford and Anjum (2011: 3) tell us that 'Something that is spherical is disposed to roll in a straight line down an inclined plane' and so sphericity can be associated with a disposition. So the defender of PD might respond to these counterexamples by arguing that such properties are to be identified with some set of related dispositions. But this is not a plausible answer to for most of the the cases in question. For example, there is no reason why all dinosaurs should have shared dispositions that are distinctive of them (otherwise it would have been easier to discover that birds are dinosaurs). More generally, members of the same biological taxon do not typically share a set of properties

distinctive of that taxon other than descent from a common ancestor. So we cannot regard 'being a member of species X' or 'belonging to class Y' as dispositional unless we think of 'being descended from Z' as dispositional—which it clearly is not. Clearly the onus is on the PD supporter to show that appearances are deceptive here—the single sphericity example isn't enough.

One response to the difficulties raised for PD in this section is simply to deny that the problematic properties are ontic: the alleged counterexamples are predicatory properties. But the PD supporter cannot embrace this approach for two reasons. First it threatens to render PD true by fiat, if the basis for excluding these properties as ontic is the fact that they are not equivalent to properties with dispositional natures; it is very hard to see how one can non-tendentiously exclude these properties while including properties such as fragility and being hot. Secondly, it undermines arguments for PD that claim that PD accounts for macro phenomena such as causation. Such arguments seek to account for all causal relations, including those involving macro properties, and so must aim to include these properties, not exclude them. (If such arguments accounted only for causation at the fundamental level then they would not support PD but only PM_F .)

If one accepts these as counterexamples one might still hold on to MPT, regarding them as some of the properties that are not powers. Nonetheless, MPT is weakened to the extent that if it is accepted that all these macro properties of science are non-powers, then there is an additional burden of proof on MPT to show that powers really are needed in our ontology of macro properties. I don't think this burden is easy to carry. For example, Mumford and Anjum (2011) and Molnar (2003) hold that macro powers can give us an account of macro causation (see below for details). But it just does not look as if the relevant explanatory properties can always be powers, because often (at least) the properties are not dispositional in nature. Consider the following. 'What caused the croquet balls to perish in the fire but not the pétanque balls? The fact that the former were made of wood but the latter were made of steel.' Here the properties of being made of wood and being made of steel are causally relevant. They are not dispositional in nature but concern constitution. Likewise, the (philosophically) often-cited property of oxygen being present is a causal factor in

explaining the fire, but again concerns constitution not disposition. So once it is admitted that there are non-power macro properties that are causally explanatory, it becomes pressing for MPT to show that *any* macro powers are required.

4 Are compounds of powers also powers?

Perhaps appearances are misleading, and we should think that the properties that are apparent counterexamples are dispositional after all because we have independent reasons for thinking that all properties are powers. We have seen that the standard A-type arguments would establish only FPT, not MPT. Nonetheless, suppose (as I do) that all the (intrinsic) facts about a world supervene on the instantiation of all the fundamental properties (including relations). Since the non-fundamental properties supervene on the fundamental ones it would seem to follow that if the latter are powers then so are the former. Surely something constructed out of powers will itself be a power? If so we do not need to quibble over whether the alleged counterexamples really are counterexamples or really are ontic properties. Supporters of PM_F at least will be forced to agree that, appearances notwithstanding, if those properties are genuine ontic properties then their true natures must be dispositional. Likewise, even if MV_F is true, one would expect there to be macro powers that are the properties constructed out of those fundamental properties that are powers. In this section I show this reasoning to be fallacious.

The paucity of discussion in the literature of the nature of non-fundamental properties may suggest that the assumption is widespread that a property supervening on powers will itself be a power.⁹ That assumption is nevertheless false. A power is dispositional by nature, so the assumption we are considering requires in particular that a property that is built out of components that are dispositional in nature will itself be dispositional in nature. As Mumford and Anjum (2011: 175) put

⁹I note that Molnar (2003: 28–30, 36–7) is an exception. He is clear that there are ‘derivative’, non-basic properties and that these include structural properties that are clearly not dispositional. Molnar is thus not a pandispositionalist. He does not discuss, however, the reasons for thinking that there *are* macro powers, given that he has a sparse theory of properties and that he acknowledges that some macro properties are not powers.

it ‘Dispositions compose to form ‘bigger’ dispositions’. But that is not the case. A conjunction of dispositions is not typically equivalent to any disposition. Consider the obvious proposal:

x is disposed to manifest M_a when subject to stimulus S_a **and** x is disposed to manifest M_b when subject to stimulus S_b
iff
 x is disposed to manifest (M_a **and** M_b) when subject to stimulus (S_a **and** S_b).

Consider a special explosive substance X that has been designed for safety reasons to be inert when subjected to a flame alone or when stressed alone, but which explodes with a ball of fire when both stressed and subjected to a flame together. Something made of X satisfies the disposition on the right hand side, but does not possess either of the dispositions on the left hand side (it isn’t fragile because it can be struck without breaking nor is it flammable because it can be subjected to a flame without combusting). Nor does the left to right implication hold. Consider substance Y which is both flammable and soluble. Yet there is no non-trivial disposition with the conjunctive stimulus: subjected to a flame and immersed in water. Likewise a disjunction of dispositions is not equivalent to any disposition. Again the obvious proposal is:

x is disposed to manifest M_a when subject to stimulus S_a **or** x is disposed to manifest M_b when subject to stimulus S_b
iff
 x is disposed to manifest (M_a **or** M_b) when subject to stimulus (S_a **or** S_b).

But this won’t work. For imagine that o is in fact a fragile but non-flammable glass object; it satisfies the relevant substitution for the left hand side in virtue of being fragile. Putting a flame to o will satisfy the disjunctive stimulus of the right hand side; but we would not expect the manifestation—there would be neither breaking nor combustion. In the light of that objection, one might try a disposition with a *conjunctive* stimulus and disjunctive manifestation:

x is disposed to manifest M_a when subject to stimulus S_a **or** x is disposed to manifest M_b when subject to stimulus S_b
iff
 x is disposed to manifest (M_a **and** M_b) when subject to stimulus (S_a **or** S_b).

This won't work either: substance X presents a counterexample to the right-to-left implication while substance Y again presents a counterexample to the left-to-right implication. Note that these counterexamples do not depend on assuming any particular analysis of dispositions (or that there is any such analysis). Particular analyses may allow further counterexamples—the simple conditional analysis generates counterexamples straightforwardly because the set of counterfactual/subjunctive conditionals is not closed under logical operations such as conjunction or disjunction. So we cannot blithely assume that any property built out of or supervening on powers will itself be a power.

5 Not all dispositions are powers

Let us imagine that one already accepts FPT One notes the ubiquity of macro dispositions. It is tempting to assume that the latter must powers also. The equation between power and disposition is common. Some authors are explicit about this (Mumford and Anjum 2011: 4; Marmodoro 2010b: 7) while others (as we shall see later) elide between the two without comment. It is not for me to legislate a usage and find others guilty of not observing it—if this equation is common in the literature we should accept that. But it is important to point out that there is *also* a common use of 'disposition' such that 'power = disposition' comes out false if 'power' is used to denote an ontic property that is dispositional in nature (or essence or identity). Failure to note this makes it appear that if we agree that the fragility of the vase was a cause of its breaking, and that fragility is a disposition, then we have established that a power (fragility) is involved in the causal process. This is, however, badly misleading.

In a context where ‘disposition’ and ‘power’ are used interchangeably, it is easy to engage in tacit reasoning of the following sort (where ‘F’ stands for ‘transfer heat to objects in the vicinity’): (i) the fire is disposed to F; therefore (ii) the fire has the disposition to F; therefore (iii) the fire has the power to F. But such reasoning is invalid without further premises. For while (i) is not contentious at all (pretty well anyone, except perhaps the Megarian actualist, can accept that (i) is true), (iii) is however highly contentious, being committed to the existence of a (non-fundamental) power, an ontic property that is modally fixed. In philosophical contexts such as this, ‘power’ is usually understood as having this technical sense whereas the use of ‘disposition’ is rather more fluid and ambiguous. On the one hand, as noted, it can be used as a synonym for ‘power’. On the other hand it can be used with no metaphysical baggage, consistent with the disposition to F being just a predicatory property, not an ontic one—this is the sense in which it is uncontroversial that a delicate vase has fragility or the disposition to break is stressed. The metaphysically loaded sense of ‘disposition’ makes the inference from (ii) to (iii) look valid, while the metaphysically innocent use makes the inference from (i) to (ii) look valid. But if we stick to one use, then one or other of the inferences will not be valid.

It is important to emphasize this ambiguity in the use of ‘disposition’ and in particular the fact that those who reject the metaphysics of powers do frequently use disposition talk without contradicting themselves. Humeans such as Lewis do not deny that there are dispositions. Indeed Lewis talks of dispositions at length in his “Finkish Dispositions” (1997). The fact that he is attempting an analysis of dispositions is irrelevant, for to analyse is not to eliminate. The Humean may use ‘disposition’ in a predicatory way (dispositions are abundant properties as Lewis would say). (And arguably even the Humean can think that some macro dispositions are ontic without thereby sliding into the powers ontology.) Similarly, Armstrong (1996, 1997), a noted denier of powers, never denied the existence of dispositions. In his (2010: 48–9) Armstrong says,

Typical cases of dispositions are ... solubility, elasticity, and brittleness. Associated with dispositions are certain truths ... It is a plausible thesis that in every case of cause and effect the effect can be seen as the mani-

festation of some disposition or dispositions, and such a view would be a congenial one for a Dispositionalist.

But the Dispositionalists go a great deal further than this. They wish to resurrect the old pre-Humean idea of *powers*. The Humean idea that there is no necessary connection between wholly distinct existences is completely rejected ...

Armstrong clearly does not reject dispositions, but he does reject powers. He rightly notes that the idea of a power goes well beyond the idea of a disposition, and that powers involve the denial of key elements of Humean metaphysics, whereas dispositions do not. Furthermore, he rightly observes that a dispositional account of causation ('plausible', note) does not require powers. (By 'Dispositionalist' Armstrong means someone committed to an ontology of powers.)

So there is a common use of 'disposition' that is metaphysically neutral and does not indicate that its user is committed to an ontology of powers. Where necessary I will indicate that I am using 'disposition' in this sense by talking of a 'mere disposition'. Lewis and Armstrong accept that there are mere dispositions, but deny that these properties are dispositional by nature/essence (compare: we accept that there are philosophers but deny that these people are philosophical by nature/essence).

Mumford and Anjum (2011: 5–6) tell us that causation occurs when a fire exercises its power to warm your body, changing it from cold to hot

(P) The fire has the power to transfer heat to objects in its vicinity.

The following is also true of the fire:

(B) In virtue of the high degree of molecular vibration in the fire, the fire is disposed to transfer heat, by convection and by radiation, to objects in its vicinity.

(P) does not logically follow from (B) because (P) is committed to the existence of a power whereas there is no such commitment in (B). (B) is also consistent with the following claims:

(N) The fire has the ontic property of a high degree of molecular vibration, but does not have any other relevant ontic property.¹⁰ The fire has the predicatory property of being disposed to transfer heat to objects in its vicinity, but not any ontic property whose nature or essence is captured by that description.

(H) The fire has ontic property of being disposed to transfer heat to objects in its vicinity, but the phrase, Δ , 'property of being disposed to transfer heat to objects in its vicinity' is a description which refers to the ontic property of having a high degree of molecular vibration. The description Δ does not capture the essence of the property.

(N) simply denies that there is the power that Mumford and Anjum suppose, adding that we might correctly use the phrase 'the property of being disposed ...' but that is little better than a *façon de parler*. The property in question is a predicatory property and we should not think its use commits one to any metaphysically interesting addition to ontology thereby, and in particular not a power. (H) takes a different view from (N), stating that the phrase 'the property of being disposed ...' does pick out an ontic property, but that property is not the power to heat—rather it is the causal basis of the fire's being disposed to heat. It does not pick out the power to heat, because the disposition to heat is not part of the nature or essence of the property of having a high degree of molecular vibration. (H) is consistent with Humeanism because the underlying fundamental properties can be understood as quiddities. The terminology of 'disposition' is used to refer to such properties (or those constructed from them) in virtue of the dispositional (nomic/causal) role they contingently have in the actual world in virtue of the laws of nature this world possesses. On such a view dispositions are genuine ontic properties. But such dispositions do not have their dispositional characters essentially or in virtue of their nature—there are mere dispositions. Since, on this view, mere dispositions are not modally fixed properties, they are not powers.

¹⁰One might worry that molecular vibration is not itself a fundamental property. If you have this concern, then allow 'molecular vibration' to stand proxy for the genuine fundamental description of what underlies the capacity of the fire to heat nearby objects.

The preceding section argued that we lack a reason to think that there are any powers at a macro level. That fact is very easy to overlook if we take ‘disposition’ and ‘power’ to be synonymous, since ‘there are macro dispositions’ is uncontentionally true according to one use of ‘disposition’. This point is important not just because it makes it easy to think, at least implicitly, that there are macro powers. Another reason is that, as we shall see, it is tempting to take a revealing *dispositional* account of X (where X is some philosophically interesting phenomenon) as thereby lending some confirmation to the *powers* ontology. But since Humeans and other non-powers theorists can be entirely comfortable with dispositions, that is a fallacy—witness the quotation from Armstrong above. What makes a property a power rather than a mere disposition is that it is modally fixed. So no dispositional account of X can confirm a powers ontology unless it appeals to the modally fixed nature of the properties in question.

6 From powers to causation via vectors

Out the outset I mentioned that a common approach to powers is to use A-type arguments to establish that powers exist and then to use S-type arguments to show what philosophical work they can do in understanding macro phenomena. An important example of this is the work of Mumford and Anjum (henceforth M&A). In their *Getting Causes from Powers* (2011) they give a macro account of causation in terms of macro powers. For their reasons why we should have a powers ontology at all, they refer us (2011: 4) to Mumford’s *Laws in Nature* (2004). But the latter provides only A-type arguments for powers, and as I have argued, establishes only that there are fundamental powers. In this section I want to look at their S-type account of causation in detail. The reason for doing so is that a satisfying S-type account might provide reasons to accept the powers ontology independently of the A-type arguments. I will show that M&A’s account of causation fails to do so and that it fails for reasons that are general in the sense that we can expect analogous problems to beset other macro powers accounts of macro phenomena.

While others (e.g. Molnar (2003)) have said that a powers ontology should be able to account for causation, M&A are the first to offer a systematic account. How does the powers ontology give us a theory of causation? The idea is simple: 'Effects are brought about by powers manifesting themselves' (Mumford and Anjum 2011: 7). Here is an example (2011: 5–6):

You come in from the cold and sit by the fire. You sit by the fire because it is hot, which for the pandispositionalist means that it has the power to warm your body. This shows the significance of the connection between properties and causal powers. The fire being hot would mean nothing to you if it didn't mean that it had the power to heat. Causation occurs when powers exercise themselves. In this case, causation occurs when the fire warms your body, changing it from cold to hot.

It is important to note that this is a *direct* account of causation in terms of powers. We have a 'macro' level causal process (a fire heating a person) and that is explicated in terms of a macro level power (the power of the fire). The account is intended to be an alternative theory to, among others, Lewis's counterfactual account of causation, which is also a direct account of causation, in that causation is analysed in terms of counterfactuals describing the entities (objects and properties) referred to in the causal claim being analysed. An indirect account of causation in terms of powers would be one that did not ascribe powers to the fire, but instead to the atoms or subatomic particles composing the fire. This is an important distinction, because an indirect powers account does not conflict with a counterfactual account of causation *per se* (as I explain below). On the other hand its success would therefore not confirm MPT. M&A aim at a distinctively powers account of causation—for them powers are as ubiquitous as causation. And so if their account is successful—and more successful than its rivals—that would support MPT.

A central part of the their theory is that causation is best understood along the lines of a vector model, rather than, for example, the familiar graph-like neuron diagram (which they associate with the counterfactual theory of causation). A vector has (i) a direction and (ii) an intensity. The vector character of causation is explained by the fact that powers also have directions and intensities (M&A associate this with

the primitive dispositional modality of powers). The fragility of a glass, currently unmanifested, is directed towards a certain possibility, its breaking. And it can be more or less fragile. The heat of the fire gives it a disposition which points to the warming of nearby objects; the speed with which those things warm, and how warm they get, depends on the intensity of that disposition.

I respond to this argument with two thoughts. First, this vector-feature of causation does not require powers to explain it; it is equally well-explained by a non-powers ontology. Secondly, this isn't a very good model of causation in any case, partly because the analogy between powers and vectors is over-stated, and partly because causation doesn't have the properties associated with vectors (i.e. vector addition only applies to causation in special cases).

6.1 Do we need powers to get vectors in causation?

Let us assume that a good account of causation will explain the vector-like features of causation, viz. that causes have a direction and intensity. Powers have those features and so in this respect the powers theory looks to have the potential to be a promising account of causation. I shall show that while M&A draw on the dispositionality of powers, they do not appeal to the modal fixity of powers. But it is the latter that distinguished the powers ontology. The rival ontologies can provide the *same* explanations of direction, because they can appeal to (mere) dispositions, while dispensing with the modal fixity element. Hence the powers theory has no explanatory advantage over its rivals.

Recall, from the preceding section:

(B) In virtue of the high degree of molecular vibration in the fire, the fire is disposed to transfer heat, by convection and by radiation, to objects in its vicinity,

which is acceptable to all sides of the debate, including the pandispositionalist (PD), the restricted powers monist (RPM), the Humean (MH), as well as others with a Humean basic ontology (such as Armstrong). Note that although metaphysically neutral, (B) gives us one of the two advertised vector-like features of a good theory

of causation, *viz.* direction. It tells us that a property of the fire (its high degree of molecular vibration) points to a certain effect, *viz.* the transfer of heat to objects in its vicinity. Moving from (B) to (P) does nothing to add directionality. It adds the modally fixed nature of powers, but it isn't modal fixity that generates directionality. A modally variable conception of properties does that too, in conjunction with the laws of nature. Where a powers theorist sees a modally fixed property, a Humean (such as Lewis) or a nomic necessitation theorist (such as Armstrong) will see a modally variable property (or a complex of modally variable properties) plus relevant laws of nature. The powers theorist thinks of inertial mass as pointing toward an outcome (resisting an acceleration due to a force) 'on its own' and necessarily, whereas the non-powers view will see it pointing to the same outcome in virtue of the contingent laws of nature (specifically Newton's second law). The non-powers view, such as MH, deliver just as much directionality as PD. Now it might be that we have independent reasons for preferring the powers view over the modally variable properties plus laws view. But an ability to generate the directionality of causation is not such a reason.

For the very same reasons, the powers view does not have an advantage when it comes to intensity either. For the powers theorist a range of related (co-determinate) powers will manifest with different intensities thanks to their different natures/essences, whereas for the non-powers theorist a range of related (co-determinate) modally variable properties will produce outcomes of different intensities thanks to the functional nature of the law that relates those determinables (e.g. intrinsic mass) to others (force, acceleration). Where the powers theorist sees a set of modally fixed properties (powers) whose essences vary in the intensity of the disposition conferred, a non-powers theorist, such as Armstrong (1983: 111-17), sees a set of non-power properties (quiddities, essentially categorical properties) plus a set of related laws of nature (united by a high-order functional law).

The difference between the powers view of properties and its alternatives concerns the modal nature of properties, whether they are modally fixed or modally variable. Do they have any dispositional character necessarily or contingently? Are they essentially dispositional or categorical? The features relevant to such a differ-

ence play no part in explaining direction and intensity. Consequently, the different views are explanatorily equivalent in this regard.

6.2 Are causation and dispositions vector-like anyway?

I shall now briefly comment on the idea that dispositions are vector-like and that this explains the vector-like nature of causation. M&A tell us (2011: 24):

It is useful to employ vectors because they are understood as having two essential features. Vectors have a direction, indicated by the way the arrowhead is pointing. They also have an intensity, indicated by the length of a vector. This is helpful because a power will have a direction—that towards which it is disposed—such as fragility being a disposition towards breaking. And it has an intensity. A power can be more or less disposed towards an outcome as the comparison between the electric kettle and sunlight, for the warming of water, shows.

M&A (2011: 27–30) stress a further advantage of the vector approach, in that vector addition gives a model for the composition of causes.

M&A focus almost entirely on the case of a one-dimensional quality space, for example that encompassing hot and cold. The power of the fire to heat can be thought of as a vector, whose direction is towards ‘hot’ and whose length represents the intensity of the heat. If we are thinking of the person who is sitting by the fire, there will be other factors influencing how hot they are (e.g. a draught in the room). So the circumstances of the person will need to be represented as a set of multiple vectors, as in fig. 1, where F represents *hot* and G represents *cold*. One can add these vectors using vector addition, to get a resultant vector. This models the composition of causes.

I contend that dispositions are simply unlike vectors in any useful way. As mentioned, M&A focus almost entirely on the single-dimensional case. However, you do not need vectors to model the one-dimensional case. Scalar quantities will do. Regarding the example in fig.1, we take the scalar value of each of *a*, *b*, and *c*, and also of *d*, *e*, and *f* (where the latter three are given negative values), we perform the simple

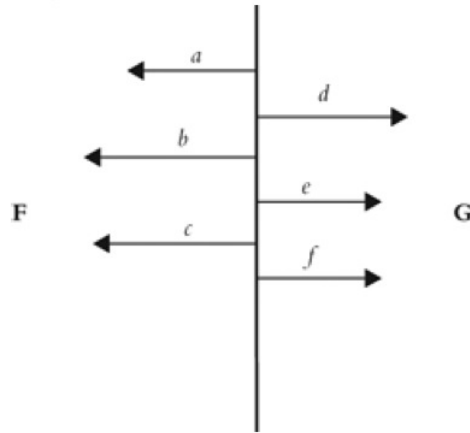


Figure 1: The composition of causes according to Mumford and Anjum (2011: 28).

scalar (arithmetic) sum, and the answer gives the composite disposition (towards heating if positive, towards cooling if the answer is negative). Since simple addition of scalar quantities suffice, we do not need vector addition, and so the vector model does no work qua *vector* model.

M&A (2011: 44) do mention dispositions in multi-dimensional quality space. For example a heater may dispose the room to be warmer and drier while the air-conditioning may dispose it to be both cooler and damper. Now we have two dimensions: hot–cold and dry–damp. However, it is a mistake to think of a multi-dimensional quality space as analogous to 3-dimensional physical space. In principle, we can rotate objects such as a measuring rod in 3 dimensions so that they are intrinsically unchanged, and thus can measure distance in any of the dimensions. And so in 2- or more dimensional space, the various dimensions are measured in the same units. This allows us to set up a system of co-ordinates to locate the position of any object in space. The direction of a given vector, \mathbf{r} , can be understood in terms of how much one has to rotate one basis vector, \mathbf{u} (e.g. a unit vector along the x axis), so that \mathbf{u} and \mathbf{r} are parallel. But these features are not in general possessed by multi-dimensional quality spaces. The different dimensions (hot–cold and dry–damp) are not measured in the same units. There is nothing akin to rotating a measuring rod so that although unchanged it points in a different direction. And so there is noth-

ing like a spatial co-ordinate system for this 2-dimensional space. Although we can locate a position in this quality space by saying for example, $\langle 14^{\circ}\text{C}, 50\% \text{ humidity} \rangle$, that's nothing other than an ordered pair of scalar quantities. We cannot transform humidity into coolness by a rotation (or anything analogous); likewise we cannot transform a disposition or tendency to make things humid into a tendency to make things cool by such a transformation. So really the talk of vectors does not do any especially interesting work. In particular the idea of 'direction' is a misleading analogy between dispositions and vectors. We can *say* that dispositions point to their possible manifestations, but this is quite a different thing from the idea of the direction of a vector. The direction of a vector is interesting because its direction can be changed by transformations such as rotation. A direction in 2-dimensional space can be described by the *angle* with one of the co-ordinate axes. But there is nothing analogous to an angle in one or more dimensional quality space.

Just as I think that the direction analogy is misleading, I also think that the intensity analogy is misleading. It seems implausible that the intensity of dispositions can be suitably modelled by the real numbers. For that we need a notion of a unit of the disposition that is the same in all relevant contexts. And that is a much more demanding requirement than simply the idea that intensities are totally ordered (i.e. they can be ordered as more or less or the same as one another and are transitive). The scalar nature of temperature is such that there is a precise meaning to the degree of difference in temperature between any two objects (as long as each is at a uniform temperature). So we can say, this glass of juice is hotter than that glass of water to the same degree as this cup of tea is hotter than that cup of coffee. Analogously, if dispositions' intensities can be modelled by real numbers, we need to be able to say—which we cannot—that John is more irascible than Jane to exactly the same degree that Rachel is more irascible than Robert, even when Jane and John are both very mild people and Rachel and Robert are both highly volatile.

Let us say that we permit, as an idealisation, the modelling of the intensity of a disposition by the scalar component of a vector. We then run up against problems of the addition of dispositions. For M&A assume—initially—that the intensities of dispositions are additive. But why should that be? The various dispositions opera-

tive in a particular circumstance may interact in quite different ways. Some people find it surprising that when one adds a litre of water to a litre of alcohol that the volume of the resulting mixture is less than 2 litres (it is about 1.94L). But mixing is not an abstract process, it involves interaction of the component substances. The same is true of the component dispositions in a complex circumstance. Eating a small quantity of chocolate may make someone happy, but eating a very large quantity is disposed to make them feel sick. Listening to a Beach Boys album is disposed to please me, as is listening to a CD of Hugo Wolf's lieder. But listening to both simultaneously will displease me a great deal. Two drugs might individually be disposed to improve someone's health, but together they will tend to do harm. Luke Glynn (2012: 1104–5) considers the example of a match where the causal powers given it by its components interact to explain further causal powers of the match, in such a way that the former cannot be considered to generate the latter by adding as vectors do.

M&A consider the case of dispositions that do not act additively (2011: 88–105).¹¹ They argue that cases of dispositions operating sequentially are no counterexample since the activation of the first disposition will change the causal context in which the second operates. So someone who eats a lot of chocolate bars is in a different causal context after the fifth bar from that in which they found themselves after only one bar. Yet, that is not a defence; it is just to concede that the vector model is inadequate. For a start it does not answer cases of non-additive simultaneous dispositions (such as the music and drug cases). But even for sequential dispositions it does not provide a satisfactory response. For if the vector model were adequate, and there are no external perturbations, then *all* the changes to the causal context would be captured by the change implied by the intensity and direction of each cause in turn. Displacement (change in position) is adequately modelled by a vector because the *only* relevant change is captured by asking how far, and in what direction. But if a change in position were to change the underlying geometry, so that the order of the changes made a difference, then those changes, being non-commutative, could not be adequately represented as vectors. M&A's answer to the problem of non-additive

¹¹In addition to the arguments I outline here, there is a defence in terms of equilibria. Glynn (2012: 1104) dismantles this attempt decisively.

simultaneous powers or dispositions in effect admits this, for they suggest that the answer is compositional pluralism: 'there are a variety of ways in which powers can compose. Addition (and subtraction) is the simplest mode of composition but it is only one among many' (2011: 97). This they assert 'requires only a relatively small amendment to the standard vector model.' But this assertion is not defended. Nor can it be: for if certain dispositions don't obey the law of vector addition, then they are not vectors nor are they vector-like. So the theory amounts to this: dispositions can be modelled by vectors, except the ones that can't.

Dispositions (qua dispositions) are thus not really like vectors at all. But that fact does not amount to a material failing in M&A's powers account of causation. That's because they are also wrong in thinking that causation has vector-like properties. Causes also do not have directions and magnitudes in the way that vectors do. As Glynn (2012: 1104) points out, there is no common metric for causes, and if there is not, 'we have no business representing the factors as vectors in a common space'. Nor, therefore, should we expect causes in general to compose as vectors do. Indeed, some of the very same cases that show that dispositions do not compose as vectors do also show that causes do not compose that way (e.g. the effect of the two drugs taken simultaneously is not the same as the sum of the effects of the two drugs taken individually). While causes can come together to have combined effects, those effects are typically not modelled as additions of the effects of the causes considered singly. In some special cases they do, when the causes are forces, for example. But it is an important empirical discovery of the scientific revolution that some causes can be modelled this way. The fact that such causes are particularly important and indeed may (arguably) underly the operation of all causes, does not imply that all causes are vectors or vector-like in the way that forces are.

So M&A's powers account of causation cannot be criticised on the ground that the failed analogy between dispositions and vectors cannot capture the genuine vector nature of causes, because causes are not in general vector-like at all. The vector business is a red-herring for both dispositions and causes. On the other hand, their case in favour of the powers theory is severely weakened. For we were considering

the claim that it is evidence in favour of the macro powers thesis that it allows us capture the vector nature of causation in an illuminating way.

6.3 A powers theory of causation?

M&A's strategy was to identify a feature of the target, namely the alleged vector nature of causation, that can be explained in terms of characteristic features of dispositions, namely direction and intensity. As it turns out on closer inspection, that explanation does not succeed since neither causation nor dispositions are like vectors in key respects. Nevertheless, had their explanation succeeded, would that have given us an independent reason to believe in macro powers? No, I have argued that it would not. That is because the relevant features to which M&A appeal, direction and intensity, are features of both mere dispositions and of powers. That is to say, as we saw in section 5, non-powers theorists (such as Lewis and Armstrong) are entirely comfortable with dispositions. I argued that they can also explain the fact that (mere) dispositions have a particular direction and intensity. What they deny is that the properties in question have those features *necessarily*—they think that properties are modally variable and so will have a different dispositional characters in other worlds. So the features of powers that M&A employ are not the features that make powers a novel anti-Humean ontology. They do not appeal to that feature of powers that makes them different from mere dispositions (dispositions understood in a metaphysically neutral way), viz. the fact that powers are modally fixed. The distinctive feature of powers, their modal fixity, is an idle cog.¹²

There is more to M&A's discussion of powers in relation to causation than just the vector model. For example they argue that powers have a primitive kind of 'dispositional modality' between necessity and contingency, explaining why causes do not necessitate their effects but are tendencies towards them. The discussion of the vec-

¹²I note in passing that an analogous point can be made against the view that powers are irreducible dispositions. For directionality and intensity are also independent of irreducibility—the latter plays no role in the M&A account of causation. Tugby (2011) uses the terminology of 'irreducible dispositions' and gives three characteristics thereof: that they have directedness, they can exist unmanifested, and they are sometimes intrinsic properties. But these are also features that are possessed by mere dispositions and reducible dispositions.

tor model nonetheless stands on its own, and as I argue below, the vector model's principal failing—that the characteristics of powers appealed to in the model are also characteristics of mere dispositions—is not unique to it. I conjecture that the same can be said of the dispositional modality. The characteristics of the dispositional modality that M&A articulate (2011: 175–81) seem to me to be ones shared with mere dispositions, i.e. the existence of the dispositional modality does not point especially to an ontology of powers.¹³

7 Powers corrupt—understanding the metaphysics of powers

I argued that A-type arguments for powers do not support MPT, the macro powers thesis. I then looked at three other strategies for establishing MPT:

(1) Macro properties are constituted out of or supervene on the micro properties of things. There are good arguments for thinking that at least the fundamental properties are powers. So the macro properties are powers also. (See section 4.)

(2) Clearly objects have certain dispositions (fragility, the disposition to warm etc.). And powers just are dispositions. So those objects have powers. (See section 5.)

(3) Powers have distinctive features, such as direction (intensity, ability to exist unmanifested etc.) that help us provide illuminating S-type explanations of certain macro phenomena of interest (See section 6.).

I have argued that these strategies fail. (1) fails because it lacks an account of how macro properties are built out of fundamental properties. In the absence of such an account, we have no reason to suppose that non-fundamental properties are powers, even if we accept that all the fundamental ones are. (2) fails because it

¹³The discussion of the dispositional modality does imply that it is inconsistent with there being an analysis of dispositionality. But as discussed above, the lack (or otherwise) of an analysis of dispositionality *per se* has no consequences for ontology.

equivocates regarding the meaning of ‘disposed’ and ‘disposition’. There is a metaphysically neutral use that accepts that the premise that the fire is disposed to heat but regards as contentious the identification of disposition and power. In this sense ‘mere’ dispositions are not modally fixed properties whereas powers are. (3) fails because the relevant distinctive features are shared by mere dispositions; the explanations of the macro phenomena do not employ the crucial distinguishing feature of powers, viz. their modal fixity. The same phenomena can be accounted for *in the same way* by mere dispositions and so these S-type applications do not support MPT.

I conclude by pointing out that other S-type projects that seek to apply the metaphysics of powers to macro level things and events suffer from exactly the same weakness of argument. Here are quotations from some authors who see a role for powers in understanding, respectively, representation, agency, and ethics in terms of powers:

Molnar’s ontology of powers is pregnant with possibilities barely touched upon by the author ... Surely it would be worth extending the power model to representational states. Indeed representation might be thought to stem from more fundamental dispositionalities present in intelligent creatures. (Heil 2004: 442)

It will be argued here that the power of agency is a meta-causal power. Ontologically, it is the power we have to modify both our *causal power profiles* and our *action profiles*, by processes of deliberation. (Ellis 2013: 186)

But it is worth recalling Molnar’s claim that the reason to accept real powers into our ontology is the work that they can do (Molnar 2003: 186). We want to add to that the work they do in moral philosophy.

Our argument is that the key notions that support the possibility of ethics are ones best explained ontologically by the existence of dispositions. We offer a big picture, which shows how a dispositional interpretation unites various moral phenomena. Moral responsibility is a

precondition for a substantial part of ethics, for example, and it is a thoroughly dispositional notion requiring what Mumford and Anjum (2011a) have called the dispositional modality. But moral responsibility also depends on there being agents who hold that responsibility. Agency requires there to be both autonomy and intentionality and each of these involves the causal powers of the agents ... Finally we will argue that value itself is plausibly best explained as a mutual manifestation between the powers of perceivers and object. ... Ethics thus appears ... to be dispositional all the way through. (Anjum et al. 2013: 231–2)

The second and third quotations come from a volume whose purpose is articulated by one of its editors, Ruth Groff, thus:

The conclusion that we have drawn is that recent developments in metaphysics have implications for the full range of areas in philosophy that have been shaped by Humean rather than Aristotelian assumptions. Our aim is to illustrate this point by providing a composite portrait of a neo-Aristotelian, powers-based approach to issues in contemporary analytic philosophy. (Groff and Greco 2013)

The issues that are encompassed by the Groff and Greco volume and which are intended to benefit from a powers-based approach include scientific realism, the will, ethics, epistemology, and social philosophy. We can classify the arguments referred to above as well as others in this volume as belonging to one of (1)–(3) above—and the appropriate responses are therefore the same.

For example, at first glance, both powers and intentional/representational states have the same interesting characteristic—the feature of ‘pointing to’ something outside themselves (i.e. dispositions/powers point to their manifestations, which may be non-actual; intentional states point to the objects or possibilities represented, which too may be non-actual). This is an example of strategy (3). One might then think that if all the basic properties are powers and have this ‘physical intentionality’ (the pointing to a manifestation feature), then the apparent mystery of how macro states (e.g. the mental states of persons) have intentionality dissolves. (The

quotation from Heil itself hints at this; cf. Place 1996, Molnar 2003: 60–3) This is an example of strategy (1). But, on closer inspection the analogy breaks down (dispositional states are not intensional whereas intentional states are) (Bird 2007a: 114–26). And even if the analogy held, the fact that the basic parts of a person have components with (physical) intentionality would do nothing to explain how the whole has intentionality—intentionality just doesn’t compose like that.

More ubiquitous, but usually less explicitly stated, is strategy (2). Above we saw that M&A are up front about their identification of ‘power’ and ‘disposition’. We may also note the elision between power and disposition implied by Heil’s use of both terms in the first quotation. Likewise, the quotation from Anjum, Lie, and Mumford also moves between power-talk to disposition-talk. We find the same disposition–power transitions in other essays in the Groff and Greco volume. I conclude this section by arguing that this is deeply misleading and that discussions of representation, intentionality, epistemology, agency, and ethics *cannot* have anything to do with powers—there is no powers account of these things; nor does any account of these things in terms of dispositions provide support for an ontology of powers.

I have already pointed out that an unreflective elision between disposition talk and powers talk allows us to move between the truism that things are disposed in certain ways to the highly contentious claim that they have various powers. I should note that the claim that there are powers is contentious and interesting when power is understood as it has been in this essay, so that powers are ontic and modally fixed properties. That’s the way that M&A, Groff and Greco, Heil, and Molnar use ‘power’. But we should note that it is possible to use ‘power’ in a less loaded way, to mean something much like (mere) ‘disposition’ with no commitment to a conception of powers as ontic, modally fixed properties. We see this use at work when an author talks of a powers theory of X, but does not deploy the modal fixity of powers in articulating or arguing for that theory.

For example, Linda Zagzebski (2013) argues for the importance of epistemic self-trust, which she defines as requiring a subject’s belief that her epistemic powers are suited to getting to the truth. Does this show that the ontology of powers is important to epistemology? No, because it is clear that when she talks about a ‘power’,

Zagzebski does not thereby intend a commitment to a theory of human powers as modally fixed properties (nor as irreducible, for that matter). Rather she is using the term in much the way we might use ‘disposition’, ‘ability’, or ‘capacity’. Certainly she does not make any reference to the metaphysical issues at question regarding the modal nature of powers. Likewise, Kallestrup and Pritchard (2013) in discussing the benefits and limitations of virtue epistemology take ‘power’ and ‘ability’ to be more or less synonymous (in this context at least). They too do not make any reference to debates or issues concerning the modal character of properties. These remarks do not imply any criticism of Zagzebski, Kallestrup, or Pritchard. For a thinking about epistemology in terms of abilities or dispositions is indeed illuminating; and it is perfectly legitimate to use the term ‘power’ in this context without its having any implications regarding modal fixity. However, without a link to the issues of modality that define the technical use of ‘power’ that has prevailed in *this* essay, then we should draw the conclusion that it is an illusion to think that their work is any kind of contribution to a wider project of showing the philosophical utility of an ontology of powers. Yet their essays appear in a volume dedicated to that project. The same can be seen elsewhere. For example, Anjum et al. (2013: 241) in their essay on dispositions and ethics discuss Isaiah Berlin’s positive conception of liberty, arguing that this kind of freedom requires empowerment, the having of powers. That seems right. But ‘power’ in the sense that makes this right doesn’t have any implications regarding modal fixity. If, as seems implicit in their essay, we use ‘disposition’ as a term that encompasses ‘power’ (in this modally neutral sense) and ‘ability’ and ‘capacity’ (as we normally use such terms), then what we are indeed being offered is a *dispositional* account of ethics. But that dispositional account of ethics, being disconnected from the modal features of powers (in the technical, metaphysical sense) is thereby disconnected from the ontology of powers. And however illuminating it is in itself, it therefore does not, despite their quoted claim above, provide any reason to believe in an ontology of real powers.

This disconnect is not simply an omission that could be rectified. There is no reasonable way in which the modal fixity of powers could be made relevant to such debates. Recall what that modal nature is: that the very same property carries its dis-

positional character in all possible worlds. Contrast the non-powers theories which hold that the dispositional character of a property depends on the (contingent) laws of nature in a world, and so will differ from one world to another. Now this difference is relevant to some debates in metaphysics, e.g. whether the fundamental laws of nature are necessary or contingent. But it cannot be relevant to debates in, for example, action theory, ethics or political philosophy. I will consider two examples.

We may ask the question, when is an action free. A natural answer is that S's ϕ ing is free when S could have desisted from ϕ ing. As is well known, this suffers from counterexamples due to Frankfurt (1969). One response accepts Frankfurt's criticism and points out that a dispositional account fares better (cf. Cohen and Handfield 2006). This response regards Frankfurt's counterexamples as finks for the disposition (Martin 1994). This permits us to say that S can be disposed to [not] ϕ even if it is false that S would [not] have ϕ ed had S so chosen. This dispositional account sheds valuable light on the debate about free will. However, for our purposes the point is not so much whether this account is correct, but to see how much or how little we are committed to ontologically if we adopt this dispositional account of free action. More specifically, does this account commit us to powers, or does its truth support a theory of powers? Above I have emphasized that ordinarily disposition-talk does not commit one to an ontology of powers: Humeans and other non-powers theorists can avail themselves of disposition-talk without contradiction. Nonetheless, there may be special features of this case that may make it especially favourable to powers. How would that work? As argued above, any such argument would have to appeal to the modal character of powers. So in this case, the pandispositional powers theorist would have to hold:

- (a) the ontic property that is the disposition [not] to ϕ should one choose [not] to ϕ is a property that confers this very disposition in all possible worlds.

What are the alternative views? They include:

- (b) there is no *ontic* property that is the disposition [not] to ϕ should one chose [not] to ϕ , only a predicatory property.

and:

(c) the ontic property that is the disposition [not] to ϕ should one choose [not] to ϕ is identical to some brain state of the subject; in some other possible world, e.g. one with different laws of nature, that very same brain state will have different effects, and so confers a different disposition in that world.

The differences between (a), (b), and (c) are irrelevant to the insight provided by the dispositional account regarding Frankfurt's case. For example, the difference between (a) and (c) only arises when we ask whether there are possible worlds with different laws that would lead to the same brain state having different effects. Such worlds, if there are any, will be relatively distant possible worlds. But the insight of the dispositional account draws only on what occurs in nearby worlds, ones where the laws of nature are unquestionably the same.

Consider a brief second example from M&A, concerning a subject with a certain ability whose possession and exercise contributes to their having positive liberty in Berlin's sense—e.g. the ability to contribute to determining the government of that subject's society (Berlin 1969). For political philosophers Berlin's idea raises interesting questions, e.g. whether positive liberty is a political concept at all, whether it can be clearly distinguished from negative liberty, whether it requires rationality, and whether its promotion requires a community or might lead to coercion. If thinking of liberty as a power is to support M&A's theory then the distinctive features of powers must play some role in answering questions such as or similar to these. As it happens, M&A make no effort to answer any such question. Not does it seem plausible that they could, for it just does not seem plausible to regard something such as the ability to contribute to determining the government of that subject's society as a power. And even if one does, the distinctive feature of powers, their modal character, could not possibly play a part in answering questions of the kind just posed. For a start, that ability seems not to be a property in an ontic sense; it certainly looks more predicatory, carrying no ontological weight. Putting that on one side, if that ability were an ontic property and a power then that same property would confer on its possessor the very same ability (viz. to contribute to determining the government

of the possessor's society) in every possible world. As before, the difference with opposing views of which ontic properties might be at work here will show up only when we consider what distant possible worlds there may be, i.e. when we consider whether or not there are worlds with different laws where the same ontic properties would have different effects. Consideration of whether such worlds exist is simply irrelevant, for example, to whether more of the power that is positive liberty will tend to go hand in hand with increased coercion, as Berlin feared.

8 Conclusion

As we have seen, an ontology of powers is popular, not just as a theory of what the fundamental natural properties are, but also as a theory of what non-fundamental natural properties are and in some cases of what non-natural properties are too. For those who see a broader role for an ontology of powers, that metaphysics can be applied to give illuminating accounts of many phenomena of philosophical interest, including causation, representation, action, free will, and liberty. I have argued that this is just moonshine. Even if powers can do useful work in explaining what the fundamental properties are and thereby in explaining what the (fundamental) laws of nature are, there is no reason to suppose that this success can be carried over to non-fundamental properties and to the philosophical issues mentioned. I have identified three reasons why it might falsely appear that powers have something to offer in the broader, non-fundamental sphere. First, some just take it for granted that the success of the powers theory regarding fundamental properties naturally carries over to non-fundamental properties. But this ignores difficult (and as yet unanswered) questions about how it is that non-fundamental properties supervene on the fundamental ones, and whether relevant features of the latter transfer to the former. Secondly, there is an equivocation between 'disposition' and 'power'. That equivocation is dangerous, because disposition-talk is not the preserve of the powers theorist. Failing to be sensitive to this point means that an illuminating *dispositional* account of some phenomenon X is misinterpreted as a *powers* account of X. Thirdly, one might identify distinctive features of powers that are shared with the

philosophical explanandum (e.g. causation). But this fails to appreciate that the sole truly distinctive feature of powers is their modal fixity, as the powers theorist conceives of them—for other alleged features of powers (e.g. direction and intensity) can be explained equally well by non-powers theorists, including Humeans. And we do not see the modal fixity of powers playing an explanatory role in the relevant philosophical explanations. So the claim that the properties are specifically *powers* is redundant.

I conclude therefore that these enthusiasts for a wider ontology of powers have over-reached themselves. They need to be much more circumspect when seeking to extend the powers ontology beyond the fundamental level in order to avoid the corrupting effect of excess powers.

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